REMARKS/ARGUMENTS

Reconsideration and allowance in view of the foregoing amendment and the following remarks are respectfully requested.

Claims 1 and 4 were rejected under 35 USC 102(b) as being anticipated by Yamada with or without the further evidence by Fujishiro et al. Furthermore, claims 1, 2 and 4 were rejected under 35 USC 102(b) as being anticipated by Ueno. Applicant respectfully traverses these rejections.

At the outset, with respect to the rejection based on Yamada, with or without Fujishiro, the Examiner's respectfully reminded that anticipation under Section 102 of the Patent Act requires that a prior art reference disclose every claim element of the claimed invention. See, e.g., Orthokinetics, Inc. v. Safety Travel Chairs, Inc., 806 F.2d 1565, 1574 (Fed. Cir. 1986). While other references may be used to interpret an allegedly anticipating reference, anticipation must be found in a single reference. See, e.g., Studiengesellschaft Kohle, G.m.b.H. v. Dart Indus., Inc., 726 F.2d 724, 726-27 (Fed. Cir. 1984). The absence of any element of the claim from the cited reference negates anticipation. See, e.g., Structural Rubber Prods. Co. v. Park Rubber Co., 749 F.2d 707, 715 (Fed. Cir. 1984). Anticipation is not shown even if the differences between the claims and the prior art reference are insubstantial and the missing elements could be supplied by the knowledge of one skilled in the art. See, e.g., Structural Rubber Prods., 749 F.2d at 716-17.

It is respectfully noted that claims 1 and 4 can not properly be rejected over the combination of Yamada and Fujishiro. But even if the Examiner selects a single said reference as a basis for the rejection it is respectfully submitted that revised claim 1 is not anticipated by nor obvious from the applied art. In this regard, claim 1 has been amended to recite more specifically that a crystal phase containing silicone dioxide intervenes between the solid electrolytic sheet and the insulating sheet at least at a part

of a bonding boundary between the solid electrolytic sheet and the insulating sheet. Furthermore, claim 4 has been amended to recite more specifically that the solid electrolytic sheet and the insulating sheet are directly bonded to each other at a remaining part of the bonding boundary, and the feature that "a crystal lattice of the solid electrolytic sheet is [thus] directly connected to a crystal lattice of the insulating sheet at the remaining part of said bonding boundary". These features of the invention are supported in particular by page 12, lines 6-12, of applicant's specification and Figure 3a.

Thus, the present invention teaches a multilayered gas sensing element for incorporation into a gas sensor installed in an exhaust system of an internal combustion engine. More particularly, the sensing element has a solid electrolytic sheet containing zirconia and yttria, an insulating sheet containing alumina, and a crystal phase containing silicon dioxide. A bonding boundary is defined between the solid electrolytic sheet and the insulating sheet. The crystal phase intervenes between the solid electrolytic sheet and the insulating sheet at a part of the bonding boundary, and the solid electrolytic sheet and the insulating sheet are directly bonded to each other at the remaining part of the bonding boundary.

During the operation of the sensing element, a heater directly attached to the insulating sheet generates heat, and the heat is transferred to the sensing element so as to give a large thermal shock to the bonding boundary between the solid electrolytic sheet and the insulating sheet.

In the present invention, the heat transferred to the insulating sheet is smoothly transmitted to the solid electrolytic sheet through the bonding boundary. More specifically, when the sensing element is produced, for example, by sintering the sheets, the crystal phase is liquefied while causing self-reaction or interacting with components of the sheets. At this time, the liquefied phase enhances the material transfer between the sheets. Therefore, the sheets can sufficiently be bonded to each

other so as to heighten a heat transfer coefficient between the sheets. Accordingly, during the operation of the sensing element, the heat can be smoothly transferred to the solid electrolytic sheet without causing blackening or migration of the crystal phase. Further, the crystal phase containing silicon dioxide does not worsen the oxygen ion conductivity of the solid electrolytic sheet (see page 3, lines 4-19 in the present specification).

In contrast, Yamada teaches an oxygen sensor 1 sandwiched by heaters 2. The oxygen sensor 1 has an oxygen concentration cell element 8 and an oxygen pump element 16. Inner spacers 20 and 22 are placed between the elements 8 and 16. The element 8 has a solid electrolyte plate 3 and porous electrodes 4 and 6. The element 16 has a solid electrolyte plate 10 and porous electrodes 12 and 14 (see column 4, lines 7-18). Each of the solid electrolyte plates 3 and 10 is made mainly of yttria and zirconia and includes silica as a backing adhesive (see column 4, lines 25-35, and column 5, lines 54-55). The inner spacers 20 and 22 are formed of alumina sheets and are put on element 16 (see from column 5, line 67 to column 6, line 3). The heaters 2 are made separately from the oxygen sensor 1 and are placed at both sides of the oxygen sensor 1. Each of external spacers 60 is disposed between the oxygen sensor 1 and the corresponding heater 2. The heaters 2 are attached to the external spacers 60 by using heat-resistant inorganic adhesive (see column 6, lines 9-16).

However, Yamada does not teach the bonding of the solid electrolyte plate 3 or 10 and the inner spacers 20 and 22. Because no crystal phase containing silicon dioxide intervenes between the solid electrolyte plate 3 or 10 and the inner spacers 20 and 22, a heat transfer coefficient between the solid electrolyte plate 3 or 10 and the inner spacers 20 and 22 is low. Therefore, the heaters 2 must be placed separately from the oxygen sensor 1, to lower a thermal shock of heat transferred from the heaters 2 to the solid electrolyte plates 3 and 10.

Fujishiro teaches an oxygen concentration sensor 26 having a solid oxygen-ion electrolyte cylinder 28 composed of ZrO_2 and CaO and conductor members 32 and 34 fixed to the electrolyte cylinder 28 to serve as support members (see column 4, lines 10-27). The hermetic seals between the electrolyte cylinder 28 and the conductor members 32 and 34 are attained by preliminarily metalizing surfaces of the electrolyte cylinder 28. More particularly, a paste containing a metallic material is applied to the surfaces of the electrolyte cylinder 28, and the electrolyte cylinder 28 is baked to form metallic coatings on the surfaces. The adhesion strength of the coatings is enhanced by fabricating the electrolyte cylinder 28 from a material which contains, in addition to ZrO_2 and CaO, minor amounts such as SiO_2 and/or Al_2O_3. The minor amounts being present as a secondary phase distinct from ZrO_2-CaO exhibit a strong affinity for the metallic coatings (see column 5, lines 1-26).

Therefore, the teachings of Fujishiro can be applied to the connection between an electrolyte cylinder and metallic coatings enhanced by the secondary phase of SiO_2. However, Fujishiro does not teach a bonding between a solid electrolytic sheet and an insulating sheet in which material transfer occurs between the sheets via a liquefied phase while maintaining the oxygen ion conductivity of the solid electrolytic sheet.

For all the reasons advanced above, it is respectfully submitted that claims 1 and 4 are not anticipated by nor obvious from Yamada with or without Fujishiro.

Ueno teaches an oxygen sensor having a cell 1 and a heater 3. The cell 1 has a solid electrolyte body 5 of ZrO_2 (see column 2, lines 46-58). The heater 3 has an electrically insulating substrate 23 made of Al_2O_3 and a heating element 25 (see column 4, lines 40-43). An adhesive is disposed on a surface of a recess 230 of the substrate 23, the solid electrolyte body 5 of the cell 1 is disposed on the adhesive, and then the cell 1 and the heater 3 are baked, thereby forming an intermediate layer 21 between the cell 1 and the heater 3 (see column 4, lines 56-64). When the oxygen sensor is heated, the cell 1 and the heater 3 are brought into close contact, with the cracks of

the intermediate layer 21 being tightly closed. When the oxygen sensor is cooled, the intermediate layer 21 restores the original states of the cracks, and the intermediate layer 21 absorbs stresses caused by thermal shock received by the oxygen sensor (see column 5, lines 13-44). A paste-like bonding agent formed of Al_2O_3, ZrO_2 and SiO (or SiO_2) is used as the adhesive for joining the heater 3 to the cell 1 (see column 5, lines 45-56).

Therefore, Ueno teaches the bonding of the solid electrolyte body 5 and the insulating substrate 23 based on the bonding agent. However, Ueno does not teach the bonding of the solid electrolyte body 5 and the insulating substrate 23 based on a crystal phase containing silicon dioxide which enhances the bonding strength.

With regard to claim 4, in Ueno, the solid electrolyte body 5 and the insulating substrate 23 are bonded to each other through the intermediate layer 21. Therefore, the solid electrolyte body 5 is not directly connected to the insulating substrate 23. Accordingly, no crystal lattice of the solid electrolyte body 5 is directly connected to a crystal lattice of the insulating substrate 23.

For all the reasons advanced above, it is further respectfully submitted that claims 1, 2 and 4 are not anticipated by nor obvious from Ueno.

Claim 2 was also rejected under 35 USC 103(a) as being unpatentable over Yamada in view of Esper et al. Applicant respectfully traverses this rejection.

Claim 2 is submitted to be patentable over Yamada for the reasons advanced above. The Examiner's further reliance on Esper does not overcome the deficiencies of the primary reference noted above. It is therefore respectfully submitted that claim 2 is also allowable.

Claim 3 was also rejected under 35 USC 103(a) as being unpatentable over Yamada or Ueno in view of Ishiguro et al. Applicant respectfully traverses this rejection.

Claim 3 is submitted to be patentable over Yamada and Ueno for the reasons advanced above. The Examiner's further reliance on Ishiguro does not overcome the deficiencies of the primary references noted above. It is therefore respectfully submitted that claim 3 is also allowable.

Claim 5 was also rejected under 35 USC 103(a) as being unpatentable over Yamada or Ueno in view of JP-26409. Applicant respectfully traverses this rejection.

Claim 5 is submitted to be patentable over Yamada and Ueno for the reasons advanced above. The Examiner's further reliance on JP-26409 does not overcome the deficiencies of the primary references noted above. It is therefore respectfully submitted that claim 5 is allowable as well.

Claim 6 was also rejected under 35 USC 103(a) as being unpatentable over Yamada or Ueno in view of JP-08-114571. Applicant respectfully traverses this rejection.

Claim 6 is submitted to be patentable over Yamada and Ueno for the reasons advanced above. The Examiner's further reliance on JP-08-114571 does not overcome the deficiencies of the primary references noted above. It is therefore respectfully submitted that claim 6 is also allowable.

New claims 14 and 15 have been added to this application to further clarify the invention. Claim 14 is supported by page 12, lines 17-20 and by Figure 3C and claim 15 is supported in particular by page 11, line 31 – page 12, line 2.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in condition for allowance and an early Notice to that effect is earnestly solicited.

Respectfully submitted,

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